Examining Finland's Noteworthy Education System

An Honors Thesis (HONR 499)

by

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November 2013

Expected Date of Graduation

December 2013

Abstract

Finnish students have received the leading scores on the Programme for International Student Assessment (PISA) test in reading, mathematics, and science multiple times. The PISA standardized test is given to nearly half a million fifteen-year-olds in over forty countries around the world. Students from the United States of America placed somewhere in the middle. What makes the difference? Finland began drastically reforming their education system over forty years ago, and now has students who outperform others worldwide. The United States of America may benefit from a similar education reform, and it would be advantageous for Americans to learn about a reform movement that has been successful. As a future mathematics teacher, I am interested specifically in how the mathematics programs differ between the two countries. The purpose of this thesis is to analyze Finland's revolutionary education system, and compare mathematics education in Finland to mathematics education in the United States of America. My study will include the middle and high school mathematics curriculum, assessment methods, classroom demographics, and teaching conditions in each country.

Acknowledgements

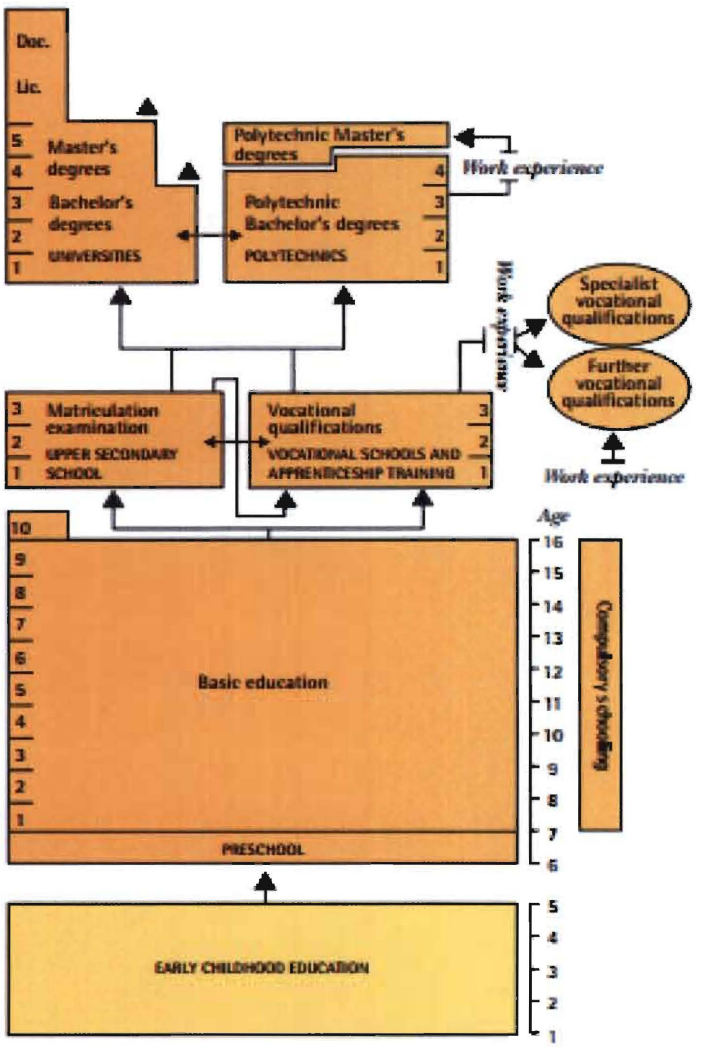
I would like to thank my husband and my wonderful family for encouraging me to work hard and achieve my goals. I could not have made it through my college career without them. A special gratitude goes to my son Jaxson, who is my motivation to always do better and push forward.

I would also like to thank Mrs. Elizabeth Bremigan for advising me through this honors thesis. She has always been there for help and guidance over the years, and I knew I could count on her for assistance with this project.

Introduction

Finland is well known for its incredibly high-achieving students. According to *Stanford News* (Tung, 2012) Finnish students have received the leading scores on the Programme for International Student Assessment (PISA) test in reading, mathematics, and science since testing started in 2000, while students from the United States of America placed somewhere in the middle. Can Finland's outstanding lead be attributed to their unorthodox education system? About forty years ago, Finland was facing numerous problems with their education system, but they have managed to turn it around and build a great resource for all Finnish citizens. It may not have been an easy task, as resolving any educational issue never is. The United States of America is currently facing some complex problems with education: declining graduation rates, low standardized test scores, poverty, immigration, etc. However, the United States does not have a national education system like Finland does. Instead, most decisions about education are made by each state. This makes for a variety of curriculum standards and school structures, but there are common themes throughout all American schools, which are drastically different than Finnish schools. Among those differences are the middle and high school mathematics curriculum, assessment methods and frequency, classroom demographics, and teaching conditions.

THE EDUCATION SYSTEM OF FINLAND



In Finland, one of the basic principles of education is equity. All Finnish citizens are provided with the same opportunities to education, and education is free at all levels from pre-primary to higher education (The Finnish National Board of Education 2012). The Finnish National Board of Education designs

legislation, core curriculum, and qualification requirements to formulate equitable schools for Finnish citizens. All students are also provided with a daily meal and transportation at no cost to the family. Most education is publicly funded and maintained, but all schools in Finland follow the national curricula and qualification requirements. Hence, private institutions and public schools are very similar.

Students are provided with multiple pathways to a higher education and the privilege to choose the learning path that interests them. For example, all students complete pre-primary education and basic education, and then they are given the choice between general upper secondary schools or vocational institutions. After completing one of these options, students can choose between universities and polytechnic schools. Early childhood education and care is available to every child, with the focus of balanced growth, development and learning. Fees are moderate and are based on parental income. Pre-primary education is free and voluntary for children, and almost all 6-year-olds participate. Comprehensive school begins when a child is seven years old and lasts nine years. Parents are free to choose to which comprehensive school to send their child. Upper secondary school consists of two options, general and vocational. There are 119 study programs leading to 53 vocational qualifications in the upper secondary vocational schools. There are higher education schools to follow upper secondary, and students can choose between universities and polytechnics. Adult education is also popular in Finland, with the main goals being to ensure the availability and competence of the labor force. Life-long

learning is encouraged in Finland, especially in the forms of training, certifications, liberal adult education, and staff development.

Finland has built their reformed education system upon the values of trust and responsibility. The schools are given the authority to determine class sizes, manage budgets, and provide educational services according to their own vision. Teachers are given pedagogical autonomy and decide for themselves which methods of teaching to use and which textbooks and materials they want to utilize in their classrooms. There is a national core curriculum, but education providers draft their own curricula within the framework of the national core curriculum. Autonomy is particularly high in the vocational field and polytechnics schools, where operations are built on educational freedom and research.

Before the education reform, quality assurance was based on norms and inspections. Now, evaluation has been decentralized, and Finnish schools employ the ideology of steering rather than controlling. The actions of educators are guided by legislation, curricula, and qualification requirements, but there is a strong focus on self-evaluation. The education system depends on the expertise of the educators and staff members. National evaluations of learning outcomes are based on a randomized sample of students, and all subjects are evaluated according to the criteria set forth by the Ministry of Education and Culture. The purpose of these evaluations is to identify needs that are essential for improvement and develop education. There are no national tests for students in basic education, but teachers are responsible for assessment of their own students. The first national test is called the matriculation examination and is

given to all students at the end of general upper secondary education. This test determines certification in language and three other content areas chosen by the student. Each student must pass the matriculation examination in order to be eligible for high education.

Most university students aim to earn a Master's degree, which takes an average of six years to complete. Students can also study for a Doctorate or Licentiate degree. The time to complete these degrees depends of the program of study. Degree studies at polytechnics give a higher education qualification in combination with practical professional skills, since most studies include practical on-the-job training. It takes about the same amount of time to complete degrees in polytechnics and universities.

In Finland, teaching is a desired career, which means that teacher education is highly competitive. Only about ten percent of applicants are accepted into the teacher education program. Therefore, universities are able to choose the best and the brightest candidates to be accepted into the teacher education program. All teachers earn a Master's degree and pedagogical training prior to beginning their teaching career. Also, teacher education programs are standardized throughout Finland, so all teachers receive the same training regardless of which institution they attend. Vocational teachers are also required to have at least three years of work experience in their respective field. One of the main reasons for the popularity of teaching is the fact that Finnish teachers are considered professionals. Teachers are trusted individuals who have been given professional freedom and opportunities to influence their work.

They are not evaluated through any external or formal procedures, but principals at individual schools are responsible for preserving high quality teaching. Teachers are also expected to continue their education through in-service training sessions and programs throughout their career (The Finnish National Board of Education, 2012).

Mathematics Curriculum

In Finland, the National Board of Finnish Education designs a national core curriculum for basic and upper secondary education. In the United States of America, we do not have a national education system, and most educational decisions are made by each state. Therefore, Indiana chooses the common core curriculum for all schools in the state of Indiana. This study will focus on the Finnish mathematics curriculum and the Indiana mathematics curriculum.

The Finnish mathematics standards for basic education are separated into three groups based on grade level: 1-2, 3-5, and 6-9. Each group has a list of core content areas and objectives for each area. The focus of this study will be on the standard for grades six through nine, which is comparable to a middle school grade range in the United States. The core contents for grades six through nine include thinking skills and methods, numbers and calculations, algebra, functions, geometry, probability and statistics (National Core Curriculum for Basic Education, 2004). The objectives for thinking skills and methods involve functions that demand logical thinking, interpretation of concepts needed for comparisons, interpretation of mathematics texts, introduction of proof, solving combinatorial problems, use of tools and drawings, and history of mathematics. Many of the ideas presented in these objectives stream into the objectives of other content categories. The objectives for numbers and calculations include building on concepts presented in previous grades, such as strengthening basic calculations, time calculations, reducing fractions, and

rounding. New concepts include rational numbers, prime numbers, square-root calculations, absolute values, reciprocals, percentages, and powers.

Algebra objectives include expressions, exponential expressions, polynomials and operations, concept of the variable, equation, inequality, domain, solution set, solving first-degree and quadratic equations, solving systems of two equations, and formulation of number sequences. The functions objectives include representing correlations using variables, concept of the function, graphical function representation, graphs of functions, the linear function, and direct and indirect proportionality. Geometry objectives consist of relationships between angles, concepts related to triangles and quadrangles, regular polygons, the circle, three-dimensional figures, similarity and congruence, geometric construction, congruence transformations, Pythagorean theorem, triangle and circle relationships, trigonometry, and calculating perimeter, area, volume and surface area. The objectives for probability and statistics include the concept of probability, frequency, concept of dispersion, interpretation of diagrams, gathering information and presenting it, and determining average, mode and median.

In comparison, Indiana's academic standards are separated by grade level from Kindergarten through eighth grade and then by course. Typically grades six through nine include the curriculum for grades 6, 7, and 8 as well as Algebra 1. Each grade level has the same set of seven standards and each standard has a list of sub-standards. For grades six through eight, the standards are number sense, computation, algebra and functions, geometry, measurement,

data analysis and probability, and problem solving (Indiana Department of Education, 2009). The sub-standards for number sense include comparing and ordering positive and negative integers, decimals, fractions and mixed numbers, finding multiples and factors, scientific notation, square roots, fraction to decimal conversion, properties of rational and irrational number expressions, exponents, powers, and roots. The sub-standards for computation include solving problems using integer operations, fractions, decimals, ratios, proportions, percentages, and computation of rational numbers. The sub-standards for algebra and functions are comprised of writing verbal expressions and equations, evaluating algebraic expressions, solving and graphing simple linear equations, representing geometric relationships algebraically, expressing quantitative relationships using algebraic terminology, solving simple linear inequalities, evaluate exponential expressions with integer powers, graph functions, and understand the concepts of slope and rate.

The geometry sub-standards include properties of plane and solid geometric shapes, geometric constructions, and identifying qualities of shapes. Measurement sub-standards include using measurement of plane and solid shapes to solve problems, calculating temperatures and money, comparing units of measure, computing perimeter, area, and volume, and conversion of units and rates. The data analysis and probability sub-standards are comprised of computing statistical measures, theoretical and experimental probabilities, making predictions, and identifying relationships among variables in a data set.

The problem solving sub-standards all involve the concept of making decisions about how to approach problems and communicate their ideas.

Indiana's Algebra standards are in a separate standards bank. There are nine Algebra objectives covering operations with real numbers, linear equations and inequalities, relations and functions, graphing linear equations and inequalities, pairs of linear equations and inequalities, polynomials, algebraic functions, mathematical reasoning and problem solving, and quadratic, cubic, and radical equations. Each of these standards has sub-standards with specific tasks that students in algebra must be able to do.

Finland and Indiana have generally comparable curricula for their middle school mathematics regarding what concepts are taught. The main difference I found between the two is that Indiana's Mathematics standards are very simplistic, and there is not much description of the mathematical concepts. Finnish curriculum is much more descriptive as to what the specific tasks a student who completes a given grade needs to be able to do. In fact, the curriculum includes a description of good performance at the end of each grouping of academic standards. Indiana's curriculum does not have anything like this, but instead good performance in each grade level is determined by performance on standardized tests such as ISTEP and the Algebra End of Course Assessment.

In Finland's general upper secondary schools, there are two different mathematics syllabi, advanced and basic, and students choose which syllabus to

take (National Core Curriculum for Upper Secondary Schools, 2003). The goal of the advanced syllabus is to provide students with the mathematical capabilities required to be successful in vocational studies and higher education. The basic syllabus equips students with capabilities to acquire, process, and understand mathematical information and to apply mathematics to real world situations. The standards for both syllabi are not organized by grade level or specific course, but instead by concepts.

The advanced mathematics syllabus includes functions and equations, polynomial functions, geometry, analytical geometry, vectors, probability and statistics, the derivative, radical and logarithmic functions, trigonometric functions and number sequences, and integral calculus. There are also three additional specialization courses offered for number theory and logic, numerical and algebraic methods, and advanced differential and integral calculus. The curriculum includes a list of objectives and core contents for each of these concepts.

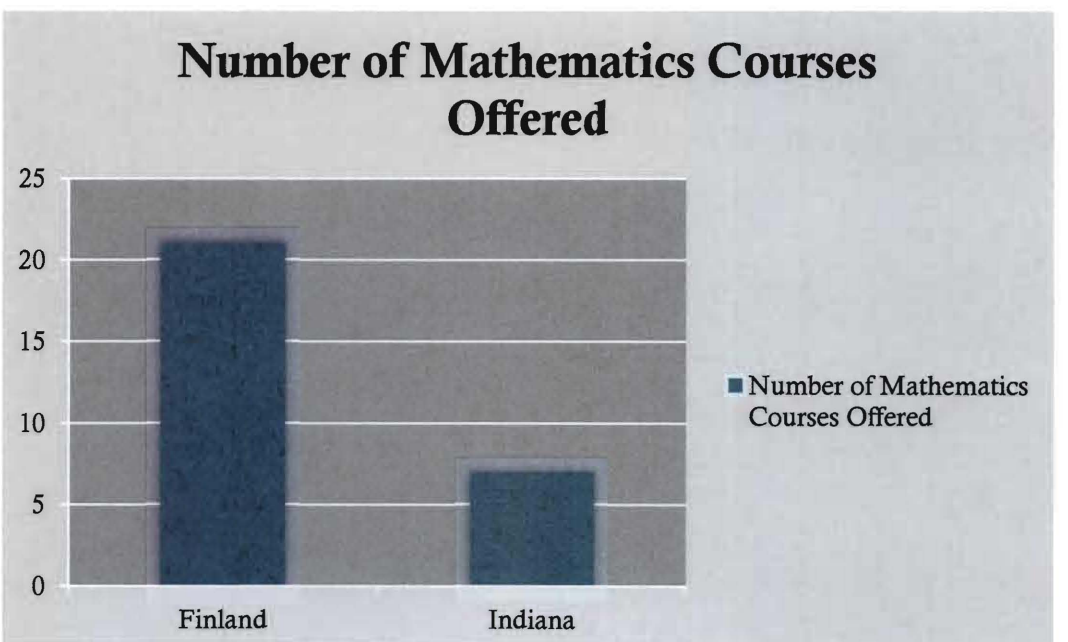
The basic mathematics syllabus includes expressions and equations, geometry, mathematical models, mathematical analysis, statistics and probability, and mathematical models II. There are also two specialization courses offered in the basic syllabus for commercial mathematics and mathematical models III. Again, each of these concepts has a list of objectives and core contents to be covered in the course.

In Indiana, all students are pushed to earn a Core 40 Diploma, which requires them to take Algebra I, Algebra II, and Geometry. To earn a Core 40 Diploma with Academic Honors, the student must also earn 2 additional Core 40 math credits by taking another math course. Pre-Calculus/Trigonometry and Calculus courses are also typically offered at Indiana high schools, and many students choose to take these courses if they are planning to attend college. Indiana's Academic Standards are organized by course. Since the Algebra 1 standards were previously discussed with the middle school curriculum, Algebra II and Geometry standards will be covered with the high school curriculum.

The Algebra 2 curriculum includes ten standards covering relations and functions, linear and absolute value equations and inequalities, quadratic equations and functions, conic sections, polynomials, algebraic fractions, logarithmic and exponential functions, sequences and series, counting principles and probability, and mathematical reasoning and problem solving (Indiana Department of Education, 2009). Each of these standards has multiple sub-standards that elaborate on what the student is expected to know about the concept. The Geometry curriculum includes eight standards covering points, lines, angles, and planes, polygons, quadrilaterals, triangles, right triangles, circles, polyhedra and other solids, and mathematical reasoning and problem solving. Again, each standard has a list of sub-standards to identify what students should learn about the concept.

The most significant difference between Finnish and Indiana high school mathematics curriculum is the way Finland separates the curriculum into two

syllabi. The focus of one syllabi is to prepare for college, while the other focuses on mathematical content needed for vocational training or jobs. Finnish schools give the students more options to decide what mathematics courses they want to take, and each mathematics course has a rigorous curriculum that applies to what each student requires. In Indiana, there is only one track, but students may be moving along that track at different paces. There is no recognition of the fact that the students may have different destinations. In Indiana most high school students take the same mathematics courses before graduation, because specific courses are required for the diploma the schools want all students to receive.



Assessment

Assessment is primarily used to develop education in Finland. The Finnish Ministry of Education and Culture administers national assessments of learning outcomes regularly, but they are only given to a random, stratified sample of the students (The Finnish National Board of Education, 2012). Students are not tracked based on their performance on the assessments. The aim is to follow at a national level how well the objectives set forth by the Finnish National Board of Education are reached. The results of the assessments are used to develop and steer education where necessary. International comparisons point out the strengths of the education system and also identify areas that need attention.

During the first six years of education, children's achievement is not measured at all (Sahlberg, 2011). The goal of these years is to get students ready to learn and help them find their passion. For the last three years of basic education and throughout upper secondary education, the teachers are responsible for assessing their respective students based on the objectives included in the core curriculum. Teachers are expected to use the results of their assessments to identify strengths and weaknesses within their classrooms and to make adjustments to meet the objectives.

The first and only national assessment given to all students is the matriculation examination given at the completion of upper secondary school (The Finnish National Board of Education, 2012). This examination consists of

four tests: mother tongue and three other tests according to the student's choice. The options are the second national language, a foreign language, mathematics or one subject in general studies. Students who pass the matriculation examination are given a certificate and are eligible to enroll in higher education.

In Indiana, all students in grades 3-8 are required to take an assessment called Indiana Statewide Testing for Educational Progress Plus (ISTEP+). The purpose of this test is to measure student achievement in the subject areas of English/Language Arts, Mathematics, Science, and Social Studies (Office of Student Assessment, 2013). Indiana students are also required to pass the Algebra 1, English 10, and Biology 1 End of Course Assessments upon completion of the course to be eligible for graduation from high school.

Recently, Indiana developed a new evaluation program for educators called RISE. With this program, teachers are evaluated using multiple sources, including their students' standardized test scores. Merit pay is introduced, and student performance on the End of Course Assessments and ISTEP+ examinations determines how much the teachers are paid (RISE Evaluation and Development System, 2013).

The concept of assessment varies greatly between Finland and Indiana. In fact, assessment serves two entirely differently purposes. Finland uses assessment to develop education, and Indiana uses assessment to measure student learning and determine teacher pay. Therefore, assessment in Indiana

involves much higher stakes, and there is added pressure for students and teachers to perform well on the exams.

Classroom Demographics

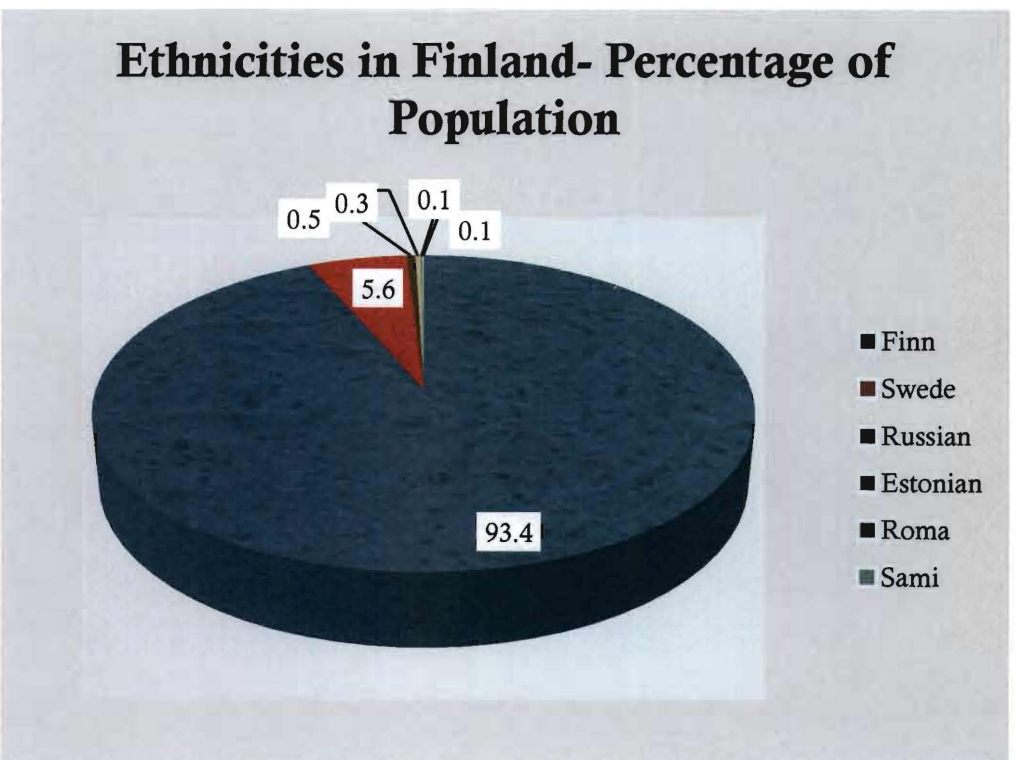
There are many important factors that effect the learning environment in the classroom. Some of these factors include student diversity, the number of students, socioeconomic status of the students, and physical attributes of the building. While all of these aspects vary from school to school, there is an average classroom composition for any given region.

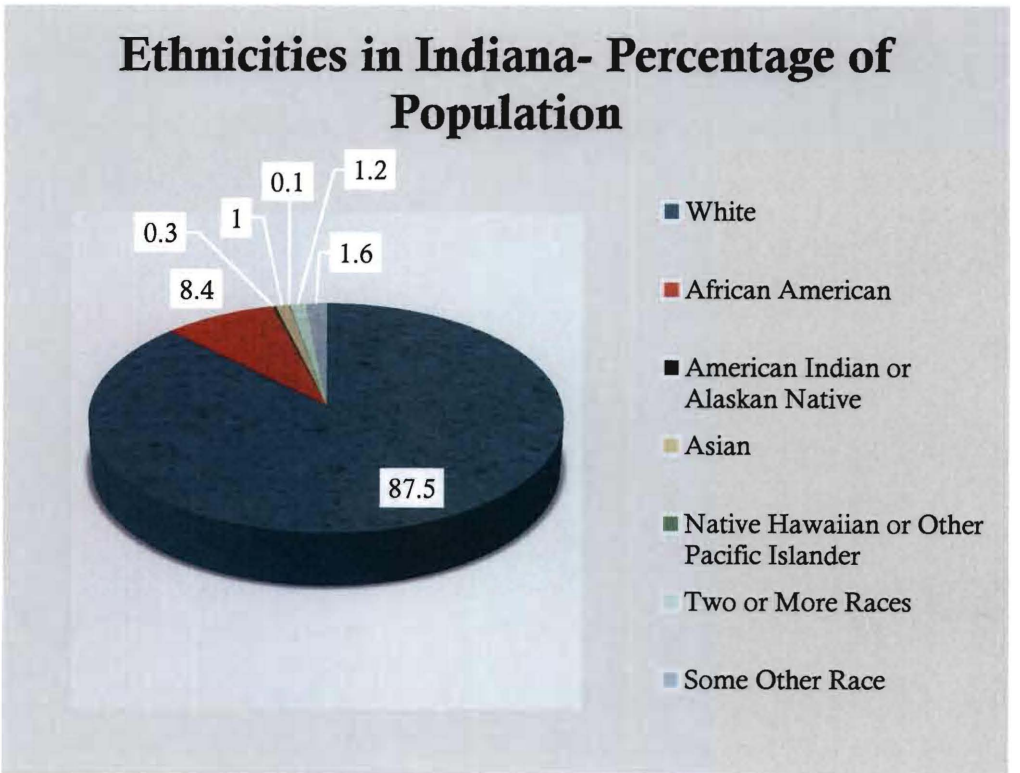
In Finland, the average class size is 20 students. The total population for the country as of July 2013 was 5,266,114 (The World Factbook: Europe:: Finland, 2013). About 93.4% of the population is of Finn ethnicity. That leaves only 6.6% of the population consisting of other ethnicities including Swede, Russian, Estonian, Roma, and Sami. Finland has two national languages, Finnish and Swedish. There is a small minority (3.3%) of residents who speak a language other than the national languages. In addition, the literacy rate in Finland is 100%.

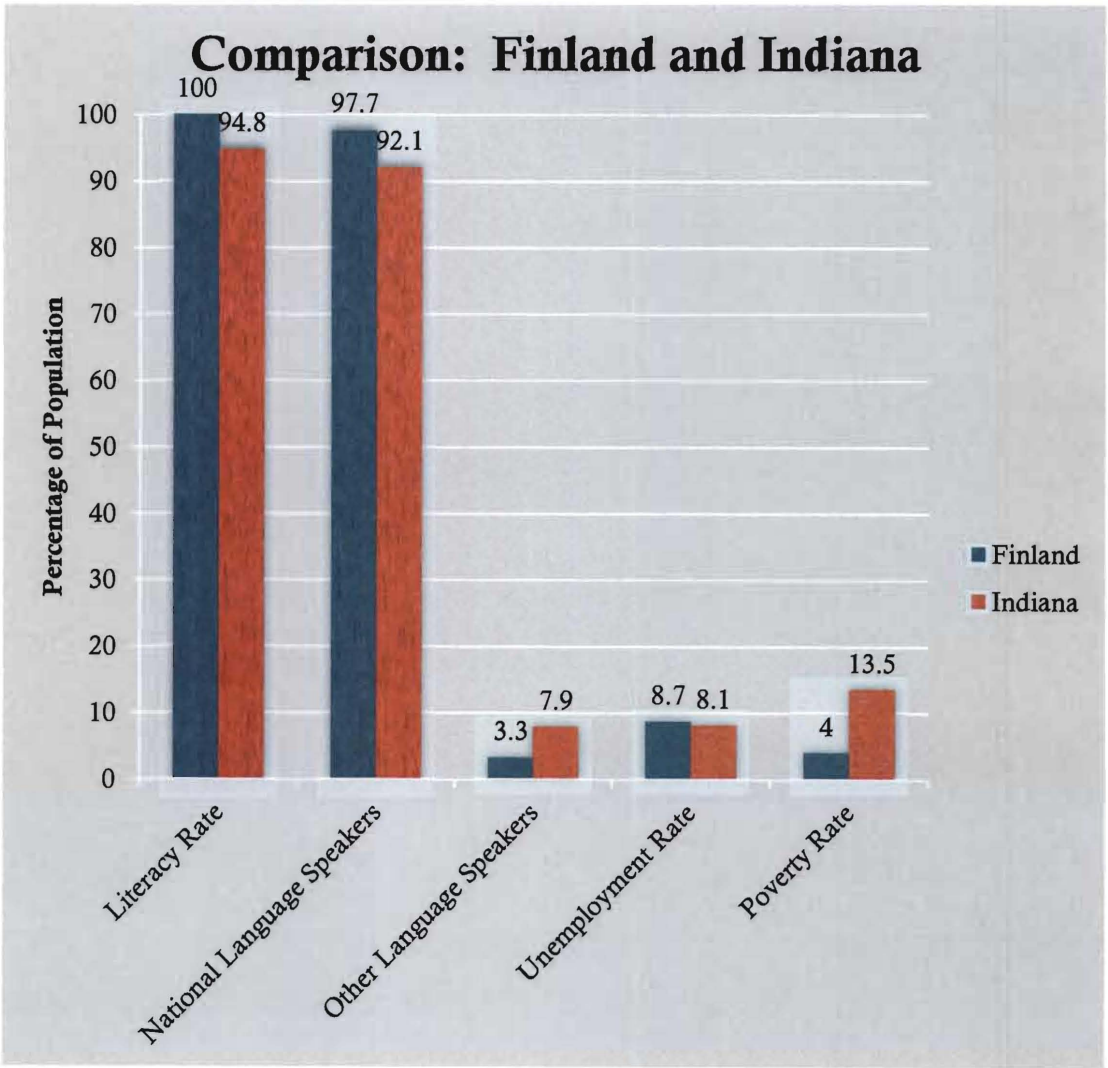
In Indiana, the average class size is 25 students. The total population for the state as of 2012 is 6,537,334 (Indiana QuickFacts from the US Census Bureau, 2013). About 87.5% of the population is of white ethnicity. The second largest ethnic group is African American with 8.4% of the population. The remaining 4.1% of the population consists of other ethnicities including American Indian, Asian, Native Hawaiian, two or more races, and Hispanic or Latino. The national language of the United States of America is English, and only about

7.9% of Indiana's population speaks a language other than English. The literacy rate in Indiana is 94.8%.

Finland has the lowest level of poverty in the world. This undoubtedly affects the socioeconomic status of children in Finnish schools and the amount of resources available to each child. The median annual income for a person in Finland is the equivalent of $64,612, which is higher than the median income of $47,697 for an Indiana resident. The unemployment rate in Finland was 8.7% as of January 2013, and the unemployment rate in Indiana was 8.1% as of August 2013. Only 4% of Finnish inhabitants are living in poverty, compared to 13.5% of Indiana residents.




Ethnicities in Indiana- Percentage of Population
0.1
1.2
0.3
1
1.6
8.4
87.5
White
African American
American Indian or Alaskan Native
Asian
Native Hawaiian or Other Pacific Islander
Two or More Races
Some Other Race


Comparison: Finland and Indiana
Percentage of Population
100
90
80
70
60
50
40
30
20
10
0
100
94.8
97.7
92.1
3.3
7.9
8.7
8.1
4
13.5
Literacy Rate
National Language Speakers
Other Language Speakers
Unemployment Rate
Poverty Rate
Finland
Indiana

Teaching Conditions

As mentioned before, teaching is a highly desired career in Finland. Finnish teachers are well-educated, well-prepared, and highly respected. All teachers are viewed as professionals, on the same level as doctors and lawyers. They are entrusted with making decisions regarding teaching methods, teaching materials, assessment, and local curricula (The Finnish National Board of Education, 2012). Teachers also participate in reform groups to prepare education reform and develop new initiatives. This positive reputation alone boosts the teachers' confidence levels in their ability to do their job and do it well.

Most teachers in Finland have working hours that are based on teaching duties. The average teacher teaches between 16 and 24 lessons per week, or about 4 lessons per day that are 45 minutes in length. Teachers are also paid for time spent doing other teaching related tasks, such as lesson planning and grading. In addition, teachers are paid for time spent participating in professional development training.

Finnish teachers' salaries are based on their tasks, the results of their work, and work experience. The possibility of accumulating extra hours is also factored into the teachers' pay. The average salary of a teacher in Finland is $28,780, which is significantly less than the average Indiana teacher salary of $50,801 (Indiana Teacher Salary, 2013). Indiana teacher salaries are based on work experience, teacher effectiveness ratings, and student performance on standardized tests (RISE Evaluation and Development System, 2013).

Conclusion

It is true that Finnish students outperform American students on the Promgramme for International Student Assessment exam, and there are many factors that contribute to the Finnish lead. Among these factors are the middle and high school mathematics curriculum, assessment methods and frequency, classroom demographics, and teaching conditions. It would be an extremely difficult and complicated task to reform all schools in the United States according to the same model. However, if each state in the United States of America took a few lessons from the Finns, American education as a whole would drastically improve. Given the similarity in population size, it is much easier and feasible to compare the education systems of Finland and Indiana. Indiana schools have much to learn about effective education, and some aspects of Indiana education can be easily altered. However, there remain external forces preventing Indiana schools from adopting much of Finland's education model.

Finland built their education system on the principle of equity. All Finnish children are given the same opportunities for education, and education is free to all students through upper secondary education. Indiana can use the same concept to provide all students in Indiana with equal opportunities at no cost to the children or families. However, this will require budgeting the state funds to allocate more funding for education and a vision of education as top priority for the future of Indiana residents.

Finland provides its students with multiple pathways for learning. Students can choose between general upper secondary education and vocational upper secondary education. In the general upper secondary education, students can choose between a basic and advanced mathematics syllabi and a variety of additional specialized courses are offered. Students in the vocational upper secondary education can choose between 119 study programs leading to 52 vocational qualifications. After completing upper secondary education, students choose between universities and polytechnics. All throughout their educational career, students are given the freedom to make decisions about what they want to learn. In Indiana, all students are pushed to take the same courses to earn the same diploma, with little room for deviation according to student interests. This is why Indiana's education system often lacks the students' motivation to succeed. The students do not get to follow their interests, so education becomes a trivial matter. Indiana has the ability to transform their education system to a child-centered model rather than a model that is focused on standardized testing.

One positive aspect about Indiana's education system is that Indiana's average teacher salary is actually much higher than the average teacher salary in Finland. Though the pay is much higher, teachers in Indiana lack the positive reputation as professionals and the community support that is so prominent in Finland. Finnish teachers are considered to be on the same level as doctors, lawyers, and engineers. Indiana teachers are burdened by an escalating negative rhetoric promoted by politicians and other public figures. Improving this

negative reputation is an easy fix if people are willing to consider everything that teachers actually do in a given school day. Also, teachers in Finland are required to earn a Master's degree before beginning their career. If Indiana's teachers were given the same requirements, teachers would be trusted more just for earning a Master's degree.

The only factors of Finland's education system that makes it virtually impossible for Indiana schools to recreate an equivalent system are the demographics. Finland is comprised of two main ethnicities: Finn (93.4%) and Swede (5.6%). The four other minorities only add up to 1% of Finland's total population. Indiana is a little more diverse, with 87.5% of the population of white ethnicity, 8.4% African American ethnicity, and the remaining 4.1% made up of 5 other minorities. There is nothing an education system can do to change the amount of diversity within its schools. It can, however, require teachers to be trained in educating a diverse group of students. This could be beneficial to all teachers throughout the United States of America. Other factors that are more difficult to change include the literacy rate, poverty rate, unemployment rate, and students who speak languages other than the national language. Indiana's percentages are higher than those of Finland for all of these issues. Little can be done to change these aspects, but teachers can learn how to combat the problems given adequate pre-service training on the subject matter.

In conclusion, there are several ways that Indiana can improve its education system by looking at Finland for inspiration. Finnish schools have dealt with many of the same difficulties that Indiana is facing today, and yet they

have transformed their system to solve the problems and come out ahead. If Indiana wants to claim the same success that Finland has, changes must be made to the education system.

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